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CANADIAN PATENT

LINER EXPANDER

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Granted to Pan American Petroleum Corporation, Tulsa, Oklahoma, U.S.A.

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PRIORITY DATE

No. OF CLAIMS

LINER EXPANDER

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This invention relates to a constant force spring device, and more particularly, to a device for expanding a metallic liner wherein an expanding die is urged against the liner by a constant force spring device.

Heretofore, a method and apparatus have been developed for installing an expanded metallic liner in an oil well or other conduit. Typically, a corrugated steel liner is inserted in a conduit which is to be lined, the greatest peripheral dimension of the liner being slightly less than the inside diameter of the conduit. An expanding tool is passed through the liner placed in the conduit, and a first-stage expanding die causes a gross plastic deformation of the liner, which is expanded outwardly against the inside of the conduit. A second-stage die on the tool then provides an additional finer deformation of the liner to provide a smoother, more finished surface on the inside of the liner and to assure more complete contact between the conduit and the liner. In a typical design of this type expanding tool, the frictional drag of the first-stage die supplies the expanding force for the second-stage die, which expanding force is a direct function of the strength, or wall thickness, of the conduit in which the liner is being installed. For example, in lining oil well casing, heavy wall casing may cause a very high frictional force which results in excessive pressure being required to push the expander through the liner. The application of the great forces required may result in rupture of the casing or in breaking the installing tool. In instances where the internal diameter of the conduit is somewhat less than that anticipated, the resulting forces can cause the tool to become stuck in the casing, or otherwise cause damage to the casing and the tool. In other designs, such as where a cantilever spring arrangement is employed in connection with the secondstage die, various difficulties are encountered in obtaining a spring mechanism having the desired strength in combination with the other spring characteristics, and with the tool dragging against the inside wall of the conduit after being passed through the liner.

Since tools of the type mentioned above often are employed in wells deep in the ground, it is highly preferable that a tool be used which under no circumstances will become stuck in the well or cause damage to the well. Any such trouble occurring in a well can result in considerable loss in time and great expense in making repairs.

An object of the present invention is a device for applying a constant force to an expanding die or other similar apparatus so that a preselected maximum force is exerted against a work piece. Another object is an improved expanding tool for installing metallic liners in a conduit, which expanding tool can apply no greater than a predetermined force to the liner being installed in the conduit. Still another object of the invention is an economical and easily fabricated constant force spring device. A further object is a rugged, easy-to-operate expanding tool employing such a spring device. These and other objects of the invention will become apparent by reference to the following description of the invention.

In accordance with the present invention there is provided a constant force spring device which comprises a body member, an elongated column element adjacent said body member, bearing plate members contacting the two ends of said column at least one of said bearing plate members being longitudinally movable in respect of the other and stop means on said body member to limit the deflection of said column element to prevent permanent deformation of said column element upon the application of a compressive load thereto. In one embodiment of the invention, the foregoing constant force spring device is employed in a tool for expanding a metallic liner inside a conduit, said constant force spring device being positioned on said tool to urge an expanding die member against the liner being installed in the conduit by a substantially constant force.

My invention will be better understood by reference to the following description and the accompanying drawings wherein:

Figures 1A, 1B and 1C, taken together, constitute a partial sectional view of a preferred embodiment of a liner expanding tool according to the present invention; and

Figure 2 is a sectional view of the apparatus of Figure 1A taken at line 2-2; and

Figure 3 is a typical plot of applied Load versus Deflection for the constant force spring device of the invention.

Referring to the drawings, Figure 1A is the bottom portion of a liner expanding tool for use in installing a metallic liner in a well, while Figure 1B illustrates the middle section of such a tool and Figure 1C represents the upper section of the tool. The expanding tool 11 is attached to standard well tubing 12 by coupling 13 and, typically, may be lowered from the surface through a well casing (not shown) to a point in the casing at which it is desired to install a metallic liner. Before inserting the tool into the well, an elongated vertically corrugated liner 14 fabricated from mild steel. or other suitable malleable material, is placed on the tool. The corrugated liner is secured in position by contact at its upper end with a cylindrical shoulder member 16 and, at its lower end by contact with a first-stage expanding die 17 in the form of a truncated circular cone which serves as a firststage expanding die in the manner hereinafter described. The expanding die is fixedly attached to a centrally located, elongated cylindrical hollow shaft 18 which forms a portion of the body of the tool. As shown, the expanding die 17 is held in place between a lower shoulder 19 and collar 21 threaded onto the shaft. A plurality of movable arms 22, preferably provided with outwardly enlarged portions 23 near the top, are disposed in the form of a cylinder around shaft 18. The enlarged portions of the arms 23 upon being moved outwardly contact the liner to perform the final step of expanding the corrugated liner into a substantially cylindrical shape. The arm members 22 are pivotally attached to the chaft so as to be movable outwardly from the shaft by a tapered expanding member 24 slidably positioned on the shaft to serve as a second-stage expander. The surface of the member 24, as shown, moves upwardly along the shaft to engage with the arms and move them outwardly. Advantageously, the inside surfaces of the arms 22 and the outside surface of expanding member 24 form mating sections, typically octagonal in shape. The expansion of the arm members is controlled by the position of the member 24 which moves upwardly

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until it contacts shoulder 26 provided on the shaft. As member 24 moves in a downwordly direction arms 22 fold inwardly toward the shaft. The expanding arms 22 are held in place on the shaft by collar 27 and circular groove 28 provided on the shaft.

The expanding tool, comprising the first-stage dis and the secondstage die is drawn through the liner to expand it in place in the casing. The
first-stage die provides a gross deformation of the liner so that it is
expanded outwardly against the wall of the casing. The second-stage die then
passes through the liner and performs the final expansion to smooth the inner
surface of the liner and to provide more even contact between the liner and
the wall of the casing and effect a fluid-tight seal.

In operation, the liner setting tool is assembled at the surface, as described above, and a glass cloth saturated with a resinous material may be wrapped around the corrugated tube to form the liner. The assembly is lowered into the well at the location at which the liner is to be set. A liquid, such as oil, is then pumped under pressure down the well tubing and flows through the passageway 29 provided in polished rod 31, through ports 32 and into cylinder 33 connected to the upper end of the shoulder 16. Upon the application of fluid pressure to the cylinder, the piston 34 secured to polished rod 31 moves upwardly in cylinder 33. As shown, rod 36 connects polished rod 31 and shaft 18 upon which is mounted the first-stage expanding die 17. When the piston 34 moves upwardly through the cylinder 33 the expanding die 17 and the secondstage die 22 are drawn upwardly into the corrugated liner 14 and "iron out" the corrugations in the liner, so that the expanded liner may contact the inside wall of the casing in which it is being installed. Positioned on the shaft below the expanding member 24 is a constant force spring member 37 which is employed to urge the expanding member against the expanding arms 22 with a substantially constant force. The force exerted against the arm members being substantially constant, the force transmitted through the arm members to the liner and to the coming will be substantially constant so that either sticking of the tool in the casing or rupture of the casing is procluded. Of course. the force provided by the opring member is procedected so that the frictional

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forces between the tool and the liner and the pressure exerted against the casing are maintained at predetermined safe levels. The constant force spring member assures that the contact pressure between the liner forming portion 25 of the arms 22 is great enough to provide the desired deformation of the casing, while preventing damage to the casing or to the tool.

The constant force spring member 37 is slidably mounted on the shaft 18 and held between the expanding element 24 and a cylindrical lower shoulder member 38 forming a portion of a differential screw element 39 which transmits the loading on spring member 37 to shaft member 18. The differential screw element comprises shaft member 18 on the outside of which are cut male threads 18a, the lower shoulder member 38 provided with female threads 38a and thimble member 41 provided with threads 41a and 41b on the outside and the inside, respectively, to engage with threads on the shaft and the shoulder. The two sets of threads are coarse, such as square, modified square, or Acme threads, to withstand very high loads and differ in pitch so that shoulder 38 is moved upwardly on the shaft 18 when the shaft is revolved relative to thimble 41. The shoulder 38 is secured to the shaft 18 by splines 45 so that it can slide longitudinally, but it is not free to rotate on the shaft. Fixedly attached to the lower end of the thimble is a friction member, such as bow springs 42, a hydraulically actuated friction pad, or other such device for frictionally engaging with the inside wall of the conduit to secure the thimble against rotation with respect to the shaft. Preferably, the direction of the shoulder member threads 38a is the same as that of the shaft threads 18a, e.g. righthand threads, and the pitch, or lead, of threads 18a is slightly greater than that of threads 36s, with the pitch ratio being close to unity. In this manner, clock-wise revolution of the shaft relative to the thimble causes shoulder member 38 to advance upward slightly and a compression load is exerted upwardly on spring element 37 to cause buckling. For example, one satisfactory differential screw was made up using five and one-half threads/inch square threads on a shaft approximately 1.7-inch outside diameter and five and threequarters threads/inch square threads on a shoulder approximately 2.5-inches inside diameter.

Constant force spring element 37 comprises column element 43, advantageously consisting of a plurality of elongated columns disposed around shaft 18. Upper bearing plate member 44 is in contact with the upper ends of the columns and is slidably positioned on shaft 18 to transmit the force of the spring longitudinally against the bottom end of expander member 24. Lower bearing plate member 46 contacts the lower ends of the columns and is moved upwardly along the shaft by longitudinal movement of lower shoulder 38 as a result of revolving differential screw element 39. Grooves 47 are provided in each of the bearing plates, to form an upper race and a lower race, into which the ends of the columns are inserted. These grooves may be shaped to conform with the shape of the column ends if desired. A cover 48 may be employed to exclude foreign matter from the spring mechanism and to protect the spring.

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A means for limiting the deflection of the columns is required. Although the column element functions in a buckled condition, application of excessive compressive load thereto would cause total failure or rupture of the columns. Therefore, a pair of stops 49 and 49a are provided for this purpose. As shown, the stops are rigidly connected to the bearing plates, and, in effect comprise upper and lower limiting sleeves positioned on the shaft to slide longitudinally thereon. The ends of the stops may move toward, or away from, each other as the load on the spring member varies. Lower sleeve 49a is prevented from moving down by lower shoulder 38 connected to the shaft 18. However, the spacing between the ends is such as to limit the longitudinal travel of the bearing plate members as they move together to prevent permanent deformation of the column element 43. Various alternative means for preventing demage to the column element may also be employed. For example, pine or rings mounted on the shaft may serve as stops, or the cover 48 provided with suitable connections may be employed for this purpose to limit longitudinal and/or lateral deflection of columns.

The columns of the column element 43 may be arranged around the shaft 18, which as shown here forms a portion of the body of the spring device, with ends of the columns fitted in the races 47. The columns may be

fitted closely together as shown, or may be spaced around the race, with separators used between them to maintain the desired spacing. The number of columns employed will depend upon column characteristics and the materials of construction. For example, the slenderness ratio of the column may be varied widely, and the column ends may be round, flat, fixed or hinged. The preferred construction is a thin, slender column with rounded ends, free to move within the races shaped to the curvature of the column ends. Materials which may be satisfactorily employed for the columns are carbon and low alloy steels, chromium and nickel-chromium stainless steels, various copper base alloys, such as phosphor bronze, beryllium copper, the high nickel alloys and other similar materials providing satisfactory mechanical properties. Typically, the individual columns are of long rectangular cross-section, with the width being greater than the thickness, and arranged so that the wider face of the columns is normal to the diameter of the shaft. Thus, with sufficient compression loading, the columns buckle, and bend about the axis having the least moment of inertia, e.g., outwardly away from the shaft 13.

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For example, a group of columns 0.167-inch thick by 0.438-inch wide by 10.626-inches long, with the ends rounded, were fabricated from A.I.S.I 4340 steel, quenched and drawn at 575°F. Each column was found to require a 20 critical compression loading of 450 pounds in order to buckle the column. After buckling, the columns were found to have a very flat spring characteristic, as shown in Figure 3, wherein P_c is the critical buckling load and point C represents the load and deflection at which the stress in the extreme fibers of the column exceed the yield point of the material. Theoretically, the shape of this spring characteristic curve is described by curve OA'ABC. Actually, this curve is described by OABC due to friction in the system. Points A and B represent typical working limits, which, of course, may be varied according to the application for which the spring is designed. For example, where a large number of flexing cycles are not anticipated, a working stress just below the 30 yield point may be used, while with a great number of flexures, the working stress may be held to less than the endurance limit of the material of construction. In the above-mentioned tests, the lateral deflection was limited to

spproximately one inch, at which the longitudinal deflection was approximately: 0.225 inches. From zero deflection to the maximum deflection, the 450-pound loading was found to be substantially constant.

In another test a spring device was built, as shown, employing 20 columns, each having a critical buckling load of 1250 pounds. The lateral deflection was limited between 0 and about 1.00 inches by appropriately positioning the stops. Upon compressional loading, the spring element buckled at substantially 25,000 pounds and from a longitudinal deflection of 0.04 inches (buckling) to about 0.15 inches the load remained substantially at 25,000 pounds.

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Of course, in designing a spring element as above it is advantageous to obtain the greatest possible value of longitudinal deflection for specified values of lateral deflection and critical buckling load, while maintaining the stress level in the columns at a safe level. The preferred columns, therefore, are laminated, as shown in Figures 1B and 2, with multiple flat members making up each column.

In the operation of the above expanding tool for setting a liner in well casing, the made-up tool is lowered into the well as montioned above, with the arms 22 in the retracted position. When the tool is at the desired level, the well tubing is revolved. The friction member 42 engages with the wall of the casing and prevents thimble 41 from revolving. With several revolutions of the tubing, lower shoulder 38 is moved upwardly by differential screw 39 to bucklo spring element 37 which has a predetermined critical buckling load. This load is transmitted upwardly against the lower end of expander 24, and its topored surface is engaged with the tapered surface on the inside of the arms 22 to urge the arms outwardly with a substantially constant force proportional to the critical buckling load of the spring element. Subsequently, the expanding tool is passed through the liner to expand it in the casing in the manner described hereinbefore.

The foregoing description of a preferred embodiment of my invention has been given for the purpose of exemplification. It will be understood that various modifications in the details of construction will become apparent to

the artisan from the description, and, as such, these fall within the spirit and scope of my invention.

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- 1. A device for expanding a metallic liner inside a conduit which 1 2 device comprises a shaft element, an expanding die member attached to said shaft element, said die member comprising a movable liner-forming member 3 positioned on said shaft and being radially movable in respect thereof to contact said liner, an expander member slidably positioned on said shaft between said shaft and said die member to move said liner-forming member 7 from said shaft, and a constant force spring member positioned on said shaft 8 to contact said expander member and to maintain said expander member against 9 said liner-forming member, whereby said liner-forming member is urged against 10 said liner by a substantially constant force.
 - 2. In a device for installing an expanded metallic liner in a conduit wherein an expanding die is moved through a liner positioned in said conduit to expand said liner: a cylindrical shaft element, an expanding die member attached to said shaft, said die member comprising a plurality of arm members disposed around said shaft and being pivotable outwardly therefrom to contact said liner, a cone member slidably positioned on said shaft between said shaft and said arm members to urge said arm members outwardly from said shaft, and a constant force spring member positioned on said shaft to contact said cone member and to maintain said come member in contact with said arm members, whereby said arm members are urged outwardly by a substantially constant force.
 - 3. The device of Claim 2 wherein said constant force spring member comprises a plurality of columns disposed around said shaft, a first bearing plate member and a second bearing plate member, each of said bearing plate members contacting opposite ends of said columns, at least one of said bearing plate members being movebly positioned on said shaft and being in contact with said come member, stop means connected to said shaft to limit the axial travel of said moveble bearing plate member along said shaft, and compression means for maintaining a lateral deflection in said columns.

- 1 4. The device of Claim 3 wherein said compression means comprises
 2 a differential screw connecting said spring member and said shaft.
 - 5. The device of Claim 3 wherein said stop means comprises a sleeve-like element connected to said movable bearing plate member and slidably positioned on said shaft and a member connected to said shaft to limit the travel of said sleeve-like element.
 - 6. The device of Claim 3 wherein said columns have a rectangular cross-section, the width being greater than the thickness, and having the wider face normal to the diameter of said shaft.
 - 7. A device for installing an expanded metallic liner in a conduit which comprises a cylindrical shaft element; an expanding die member mounted on said shaft, said die member comprising a plurality of arm members disposed circumferentially around the outside of said shaft and being pivotable outwardly therefrom to contact the liner; a conical expanding member slidably positioned on said shaft between said shaft and said arm members to urge said arm members outwardly from said shaft; a plurality of slender columns, each having a long rectangular cross-section and disposed circumferentially about said shaft; an upper bearing plate member and a lower bearing plate member, each slidably positioned on said shaft and contacting opposite ends of said columns; limiting sleeves attached to each of said bearing plate members and slidably positioned on said shaft; a shoulder momber on said shaft; a differential screw element connecting said shoulder and said shaft to apply a buckling load to said columns; said shoulder being engageable with the limiting sleeve connected to said lower bearing plate member, whereby the axial traval of said bearing plato mombers is limited; said column members transmitting their buckling load to said arm mambers to urge said arm mambers outwardly with a substantially constant force.

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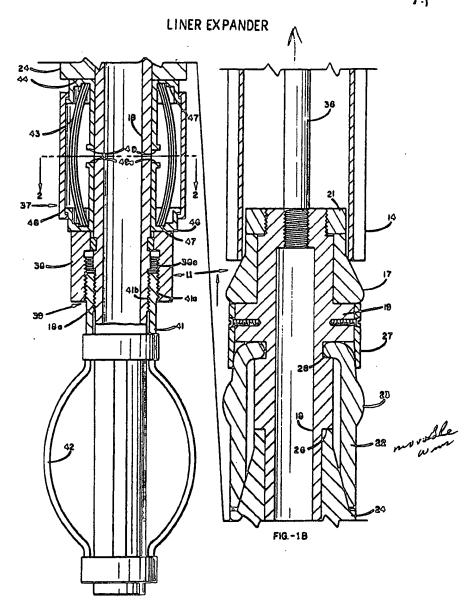
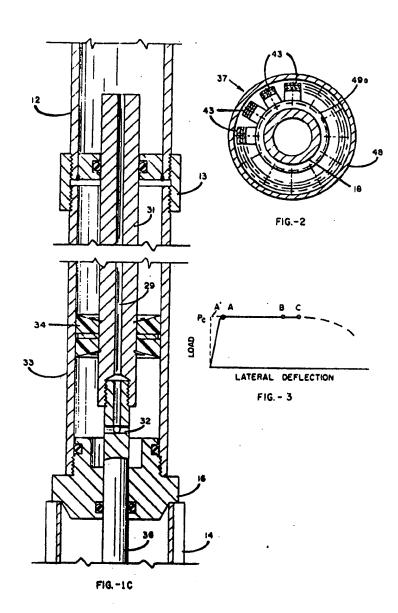


FIG.-1A



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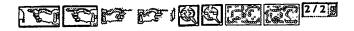
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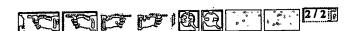


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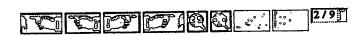
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Figure 3 to a typical piot or applied land versus deflection for the constant force operate device of the terminals.

Industries to the decrine, Pierre 14 in the better portion of a liner expending tool for one in installing a metallic lines in a coll, while Figure 10 illustrates the excite excites of each a best and figure 20 septe-क्षात क्षा प्रकृत कर्माक भी क्षा क्षात्र. की व्यक्तिका 11 to क्षात्रकी क منصدها بماء فطعر الا لم مصافح الأحط, فهاملام, من أن المعجد الحد فاء 10 FIGURE STREET IN COLUMN IS SELECT (SECTION OF SECURITY OF SECUR to sected to install a catalite liner. Betwee immedia; the test into the will, as also place mentionity composed them to tabulated the also areal, er other suitable milamble exterial, is placed on the test. The oursected liner is occured in position by contact at its upon on with a cylindrical cherilder combor 16 and, so the lower and by sentent with a first-other expecting the 17 is the form of a transport elevator seen which serves as a firstotup expending die in the expert bestratter docurters. The experiency die to finally abtached to a controlly located, electrical sylications ballow shaft lo trick force a parties of the body of the tool. As shows, the experites the 17 त्ती वान जिल्ला है कारिक का है। स्थायक प्रतान के कार्या के किया है। ments. A plumble of comple care to, presently provided out a controlly त्योग्रहको प्रकारिक की स्थार के किए, तर्न नेप्त्रकार का की केवत of a व्यक्तिक හෙත් එක් 18. බා ක්ෂල් පුණක ය හා යන නී දක කිරු සක් සේ سيطاع مصلاحة فت المحت فه وسادت فت هديا مليه ما موسطون في صحيدين ... tion ico a marticially optionical disp. The are compre at the preventy المعرضا في الشاعدة بالمستمال مستمالي عبد المستمال في المراجعة مهمالين يستثمه كا ملاهمال بمدوديسيا مه فله ملماله هو يستم بدره ومستله وهوره क्कूट्रांग. क्रिन क्टारिक को क्रिन क्टार्टर के, क्र क्टार्ट, क्टार क्टारिश कोट्स के mars to out-so with the cross and now then economity. Also temporally, the अ अवस्थित कर्माच्या वर्ष क्षेत्र क्ष्मक व्यवस्था स्था क्षेत्र क्ष्मकार क्षा व्यवस्था स्थानिक स two critics continue, topically cotogoral to atm. The conjunity of the con minors to controlled by the product of the mater to take most openally





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writh it contacts studies to provided on the staft. As maken in a consentry direction eros in that insertly toward the short. The empending arms 22 are half to place on the short by calles of east exceller proves all provided on the shorts.

The expending tent, comprising the first-stage die cal the secondoracy die to drawn through the licen to expend to the place in the section. Do first-oracy die provides a great deformation of the lines on that it is expense through the litter and particles the stage. She association die then process through the litter and particles the stage opposites to complete the little section of the litter and to provide now over supposed that there and the wall of the energy and effect a stage.

In exercision, the limit estimated took to exercise at the exercise, so described above, and a glass thou somewhat with a restaura material any by ways discret the corrected tota to two the lines. In assembly to boroth into the cell of the licetion of valor to licer to to be see. I liquid, seeb a ett, to the press where presents done the cold taking in flow threath the perceptor 29 provided in political red 31, through parts 52 and into cylinthe 35 completed to the upper and or the absoluter 16. Then the opplication of fluid princess to the epitodof, the piotes is connect to pediated and it made would to epiticie 33. As man, red 36 memorie palished red 34 and about IS the united to exercise the first-plays expecting the 17. Were the process \$4. come tradity thereof the optimizer II the committee the 17, and the optimizer story the III are these character tops the constraint time in the street ex-المناسبة المناسبة ال trails will of the coates in which it is being toutailed. Resistant to the هاه الا تحتجيد وعادره محمدة المواسعة و ما لك حماسة وبالشعود مدة المطلح المطاه io क्योकरूप ६० क्यून धेक व्यक्तवीक्ष स्थान स्थानकर ६५० व्यक्तवीक्ष स्थान ३३ वर्षक व minimially accreate force. The force asserted occitient the unit crathin being orderestably amount, the force translated through the art minor to the lins नो क के तक्का जार व व्यक्तकारिय नामित के कि कि विकास र्द क्षेत्र का का का कार्या क कार्या के कार्या के प्रत्योगी के कार्या के का فض دوس كالمواجع الما والمواجع المراجع المان الما

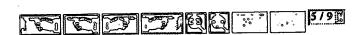


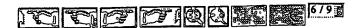
NETRANTING AND AND CONTROL OF THE PROPERTY OF



therese between the tool and the liber and the presence courted defined the moing are middled at presentant and only levels. The courtest force oping makes accurace that the contact produces between the liber founds partice 20 of the cose 20 to great march to provide the bestern definantian of the coding, while proventing demon to the coaling or to the tool.

The expected force opinion explor IT to alterate expenses a ten while मि क्य क्रिकेट के क्याने क्षेत्र के क्याने के क्याने क्षेत्र क्याने क्याने क्षेत्र क्याने क्याने क्षेत्र क्याने क्षेत्र क्याने क्षेत्र क्याने क्षेत्र क्याने क्षेत्र क्याने क्षेत्र क्याने क्याने क्षेत्र क्याने क्याने क्षेत्र क्याने क्याने क्याने क्याने क्षेत्र क्याने क्या mine to feeding a parties of a differential array along the battle beautiful थ्य क्षेत्रीक्ष क कृतेन्त्र क्यांच्य ज्ञा ४० व्यक्त क्यांच्य थ्री. ज्ञाः विशेषण्याचेत्री व्यक्त ा क्षा विकास का स्थाप के साम का स्थाप لكن التعالى والمراجع المراجع ا क्ष्मांत की प्रशासिक क्षार क्षम्पतार कीर ता क्षेत्र का का त्यांति ता का seaso, remotivate, to make with threele on the mark and the shoulder. En two क्रफ ल ध्यालके का क्यांक, क्यों स अक्टाल, क्योंगिय अ्ट्यक, वा क्रिय ध्यालक, to electronic many high lacels and differ in patch so that another \$9 to expect property on the simils in then the simils is revolved relative to thirdle bl. क्ष्म त्यानिक से हें का त्यानिक में ही के क्ष्मित को का स्थान कर का स्थान के कि langitudically, 12 it is not free to rotate as to shart. Pickly arrested ده فلن لمحمد حد ود فلت المنتك له و المنتك به و المناس حديث به المناس الم a betrouliably estuded friction per, or other such device for frictionally चल्लाला. त्वंदी क्षेत्र अंदार्थन क्यों वर्ष क्ष्य क्ष्यांकों के ०००ला क्ष्य क्षेत्रकों कि उत्पारकों المنطبة تقال المستمار الد المسائلة والمسائلة المسائلة الم مناسب فليمنان للله عن فت حسن مد فليط ما فت منطة فليمنيك لأناء 0.8. ملزك ಗ್ರಾ ಗ್ರಹ್ಮ, ದ್ರ ದ್ರ ಗಣ್ಣ, ರ ಗಣ್ಣ, ರ ರಾದ್ಯ ಸ್ಥಿ ಕ ಯೆನ್ನಡೆ ನಾರ್ಡ ಗಾ المراج معلى المراجع ال क्तार विकारण का कामान के कि कार minim to the third क्रिक المعالمة من المعالمة م المعالمة معاملة معاملة معاملة المعالمة المع trickly a gring class of to the trickles. For carple, an attornatory محصون والمعاملة المعامدة على مداة والمام والمام معم معمد الماساتانا ಲೊ ಐ ಕಿ ಕೆರ್ಲ್ ಇತಾರದದಲ್ಲೇ 1.7-ಕೂಕ ದಾಡದಿ ಚುದಾಜಕ ದರಿ ಕೇಳಿ ಆರ್ ಟಾಣtranscription through the contract of a should approximately 8.5-desires





Denates term operate observed all amprises where observed by, street terminally manifely of a phrolity of elegated column disposed around about 18. Open bouring photo mater the se contact with the dispose and of the column and to obtainly positioned as elect 18 to brown to term of the spring languaritationally equipm the botton and at appears contact to force the column and to force the terminal photo mater the local terminal to record to come and to force the column and the column and the force that the column and differential arrow almost 19. Greates 17 are provided to made of the column are interested. These presence up to appeal to contact the column are interested. These presence up to appeal to contact the column are interested. These presence up to appeal to contact the column are interested. These presence up to appeal to contact the column are interested. These presence up to appeal to contact the column are interested. These presence up to appeal to contact the column are the column and if declared. A cover the corp.

A some for Mediker the Coffeeding of the column to required. lither the color election to a booled sentrice, opplication of . and the experience as compared forces of the experience of the experience of the column. Simerature, a pair of stage 69 and 650 are provided for this parpose. to chara the chara are rightly commoted to the branks plates, and, in offen exprise that we spor frequency seems and sport on the top of the ق ملات المرافطاتيال المعمد. كم تعاد دا الم دادي شر يعد المعالي الم المراه والمراه والمراه والمراه المراه المراه المراه والمراه والمراع والمراع والمراع والمراع وا to posited from moting tem to least abundar की servoted to the abundant bil. المستعمر, والم ويسطين المنسب الم حياه ده معل مه ده المبارة والمالة والمستعمر المستعمر المستعم المحمد والمحاص والمطاهب والمحاص المحاص المحامد المحامد المحامد المحمد ರ್ಜಿನಿಸ್ ಪ್ರದೇಶ ಮದಾರ್ ನಿ. ರಿಗಳು ಯೇಗಳು ದಾಹ ಕ್ರೇ ಕೊಂಡು ತ್ತಿನ ಕೆಯ್ನುಂ ಕಂ ಜಿಎ ಜನೀನಾ ಎಟನಾಗಿ ಮತ್ತು ಮತ್ತು ಜನಾ ಜನಾವುದ್ಯಾಗಿ ಕ್ರೀಡ್ ಸಾಮ್ರಾಮ್ಯ ಕ್ಷಾಮಿಕ ರ when commend and this obtains may common and abouge, on then covers 48 provides as the catable escapeance as to explored for this perpent to limit lengthedisal ದ‡/ರ httml ಅಗಿಂಡಣ ದ ಯಾ.

So miles of the colors shows by my to provide more the country of the country of the country of the colors of the country of the colors of the

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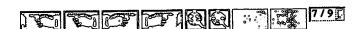




fitted classly together as above, or may be appred around the rose, with some roture used between these to extintion the destruct opening. The reserve of no mplayed will deport than column aberouteristics and the meterials of construction. For comple, the electronics robts of the column my in writer videly, and the column cults are to reach, flat, flant or hinged. The prototred contrastes to a time, closer tolers with received ande, from to move within للت مدده بخريط له لك مستعاده ما لك دماسة بعده. كالمساملة لللما من ك متناها والمادي المادي المادي والمادي والمادي والمادي والمادي والمادي والمادي والمادي والمادي والمادي ಲೇಕಾಕರ ಎದ ಮೀರ್ಮ-ಎರ್ಡಾರ್ stataloso ptools, ಸಾರ್ಚಿ ಅಂಕ್ರಸ್ ಶಿಕಾ ಮತ್ತನ, ನಿಯ or principal trouch, beryllikin support, the high model allow the other minitur minimals providing consideratory measured properties. Applically, the left-गर्थकारे कार्यक कर की देवत उच्चक्किएमेस वच्च-व्यक्ति, स्तंति के प्रतिपे विशेष prestor than the intellects, and arranged so that the viter Ison of the universe to mend to the director of the chaft. Then, with marked conservation teritor, the column bratile, and tend about the ands barries the least series of Leartin, o.g., culturally may from the shaft 18.

For comple, a group of column 5.164-tach thick by 0.838-inch wife ty 10.686-inches long, with the code repeated, were februaried from A.I.S.I 4350 step), (pression) and denot of 175%. But colors we found to regain a to critical reprocuise leading or MO pends to ender to beakle the californ. . After tending, the column was found to have a way that spring characteristhe, to there is Marie I, thirds Po to the existing beautiful from the point C represents the local collection of which the chross in the outeres fileso در به توسيع موسيم من المال المراجع من المراجع of this current observationic curve to descent but by were this animally, this curve is shourthal by MIII that to friction in the system. Potons & end I removed typical serving lights, chich, of course, my to verted committing to the application for radio the spring to declared. For comple, since a large miner of floring opilos on me mitalyated, a world a secon two blar to to yield paint my to one, eath viet a great motor of flowers, the verteing - कारणाव की धारणाव को के बावार कारणाव को करण करने कर के कारणाव के कारणाव Man. In the observational teasts, the lateral teastantine was likely to

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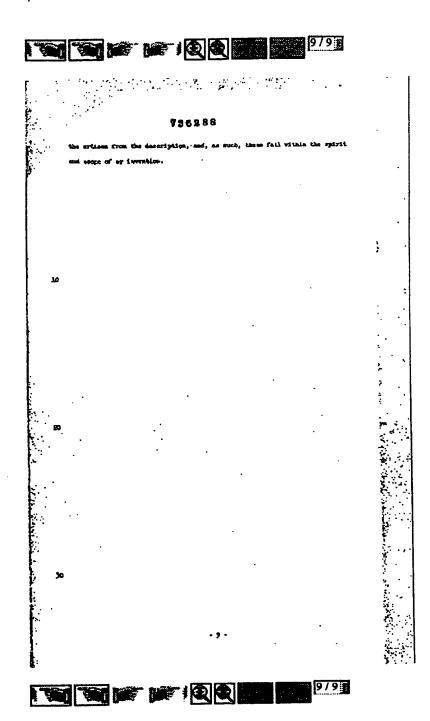
approximately one look, at which the longitudines deflection was approximately so that inches. Once was destinated to the common deflection, the \$50-point location was found to be constructed.

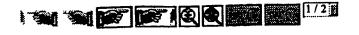
in coster data a spring device was built, as done, caploring 80 colors, each burden a critical individual fact of 1550 parts. See internal confliction was limited between 0 and about 1.00 tackes by experienced posturated to other. See expressional loading the spring element bushed as excurrentally 65,000 parts and from a sengeticism deflection of 0.00 tackes (including) to cheese of 0.15 tackes the send recorded substantially of 63,000 parts.

of occurs, in functions a spring observe on above 14 in electrocycles to obtain the processor possible value of imprincipal deficition for specifical values of lockward collection and critical textiling local, while unintending the stress lower to the collection at a case lovel. The produced collecte, therefore, ore localizated, or electric figures in that 2, with multiple flat content mixture of collection.

Description of the above committee tool for softing a linear in sail modes, whe makes tool is bound take the cold as motivated above, with the earth 20 to the restroated position. One the tool is at the bound with the cold, the sail taking is section. She friction makes to suppose with the wall at the modes, all provers thinks if the resolution, then are all the areas are all the modes. If think has a predominant or such a single from the latter than the fact that the approximate the modes of the thinks the committee that the theory of the temperature of the control of the temperature of the temperature of the control of the control of the temperature of the control of the control

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